INSTRUCTION MANUAL
TYPE 600 BAROCEL
PRESSURE SENSOR

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SUPPLIED BY

PLASMA TECHNOLOGY

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DATAMETRICS • DRESSER INDUSTRIES, INC.

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SECTION I
GENERAL DESCRIPTION

1.1 Purpose of Equipment

The Type 600 Barocel/Plus transduces absolute vacuum pressure into a dc output voltage precisely proportional to input pressure. Advanced design characteristics enable it to provide measurement over a wide range of input pressure with exceptional high accuracy and long-term stability and zero repeatability. Rugged construction permits low-range units to accommodate high overpressures without loss of accuracy.

In vacuum systems, the Type 600 is the ideal replacement for McLeod, Pirani, or thermocouple gauges. The Type 600 is also available with improved accuracy for atmospheric pressure measurements, making it ideal for barometric applications.

An integral vacuum reference contains gettering material to ensure long operating life and eliminate the need for reference vacuum pumps. Since pressure is sensed by electrically measuring pressure-induced displacement of a thin metal membrane, calibration accuracy is unaffected by chemical composition of input media.

Liquids, dirty or corrosive gases, and even radioactive gases such as tritium may be monitored without affecting accuracy because the electrically-active portion of the sensor is contained in the sealed vacuum reference.

The sensor's analog output is directly proportional to pressure, and may be recorded by data acquisition systems or read directly on a high-resolution digital voltmeter or Type 1500 Power Supply/Readout. RFI protection is standard with all instruments.

1.2 Equipment Supplied

Type 600
A mating pressure fitting, where applicable
Cable strain relief
Instruction Manual

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1.3 Auxiliary Equipment

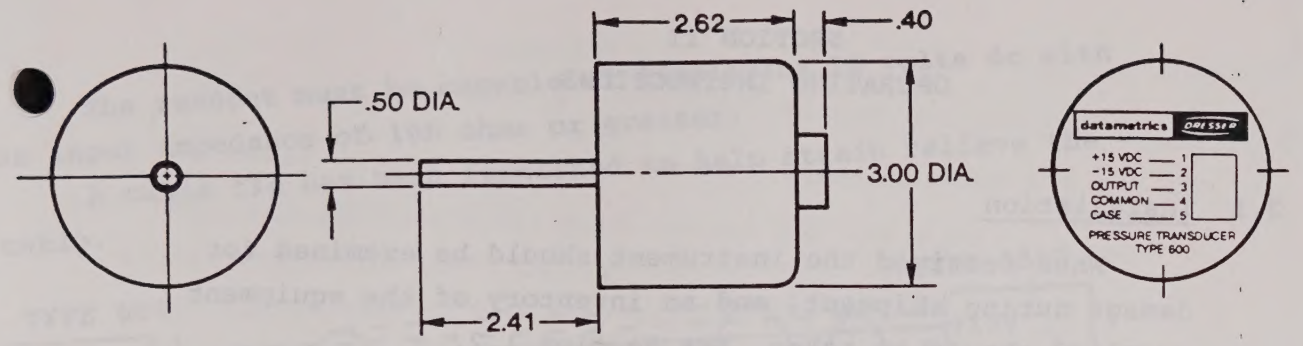
Type 1500 Power Supply/Readout

Type 716 Connecting Cable

1.4 Specifications

Ranges:	10, 100, 1000 torr
Accuracy:	standard: 0.15% of reading; optional: 0.05% of full scale rss of linearity, hysteresis, and repeatability (available for 1000 torr units only)
Repeatability:	± 0.01% of full scale
Output Signal:	0 to 10 V dc, linear with pressure
Material Exposed to Media:	Inconel
Operating Temperature:	0°C to 65°C
Temperature Coefficients:	zero: 50 ppm full scale/°C; slope: 200 ppm reading/°C; optional slope for 1000 torr units: 50 ppm reading/°C
Resolution:	1 part in 10^4 sensor full range
RFI Suppression:	standard on all models
Leak Rate to Ambient:	1 X 10^{-10} scc/sec @ 760 torr applied pressure
Volume:	8.33 cm^3 (1/2" dia. tube)
Overpressure:	1.25 times sensor full range, or 20 psi, whichever is larger
Overpressure Effects:	less than 0.03% of full-scale for 50,000 cycles to one atmosphere for 10 and 100 torr models
Pressure Fittings:	1/2" tube (standard); Cajon Ultra Torr; Cajon 8VCO; Cajon 8VCR; Mini-Conflat; KF-16
Transient Response:	8 msec
Diaphragm Resonant Frequency:	>3000 Hz
Weight:	1.5 lbs.
Power Requirements:	± 15 V dc, regulated; ± 2%, at 30 ma

OUTLINE DIMENSIONS



Explanation of Options

600A — 10T — R | 12 — H | 21 | X — 4

Measurement Mode

A = Absolute

Pressure Range

10, 100, 1000 torr (torr = mmHg)

Accuracy

R = Standard accuracy

S = Improved accuracy (1000 torr units only)

Temperature Coefficient

12 = Basic model

13 = Improved temperature coefficient (1000 torr only)

Sensor Construction

H = All-welded

Fittings

7 = Mini-Conflat

12 = KF-16

20 = Cajon 8VCR

21 = 1/2" tube (standard)

22 = Cajon 8VCO

Special Features

X = None

Output Signal

4 = 0 to +10 V dc

1.5 Identification of Controls

Zero adjust located behind the snap button hole plug

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SECTION II

OPERATING INSTRUCTIONS

2.1 Installation

When received the instrument should be examined for damage during shipment, and an inventory of the equipment supplied should be taken, see Section 1.2.

The Type 600 may be mounted in any position but it is recommended that the pressure port face downward to preclude contamination from falling into the sensor. The Type 600 will easily support its own weight on the pressure fitting.

Electrical connection may be made according to the figures below. If a Type 1500 Series Power Supply and Readout or Controller are used follow Figure 1. If other power supply and readouts are used similar grounding techniques should be followed.

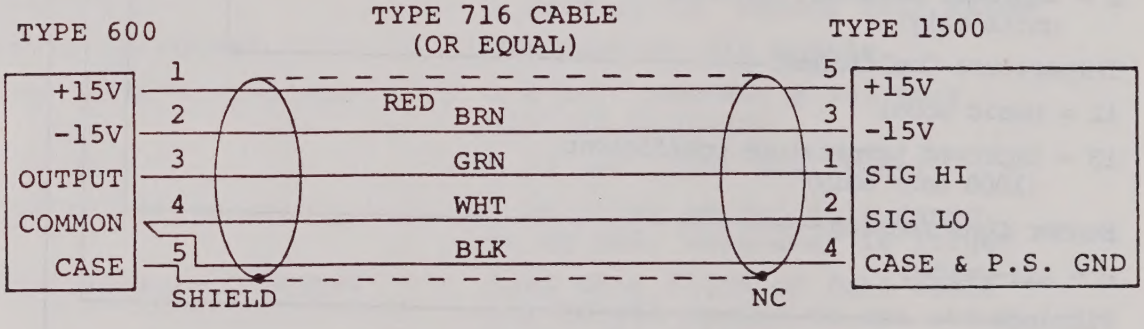

FIGURE 1

The Type 716 cable has spade lugs on the end that connects to the Type 1500 Series Power Supply/Readout and Controller and numbered tinned leads on the Type 600 end.

It is highly desirable that case grounds of all equipment be at the same potential to preclude the possibility of ground loops and noise entering the system causing erratic readings. In high noise environments shielded leads should be used as shown in Figure 2.

The power supply requirements are ± 15 volts dc regulated ± 2% at 30 ma.

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The readout must be capable of displaying 10 volts dc with an input impedance of 10K ohms or greater.

A cable tie has been furnished to help strain relieve the cable.

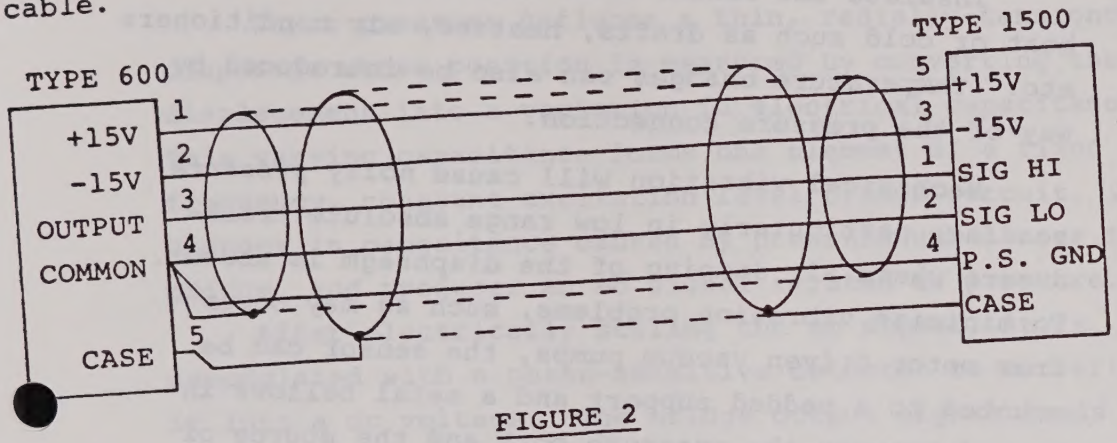

FIGURE 2

2.2 General Operating Procedure

After the installation has been completed the system may be adjusted for zero pressure reading by evacuating the transducer to a pressure lower than the readout resolution and adjusting the readout zero. If necessary the Type 600 zero can be adjusted by means of the control located behind the snap button hole plug.

TRANSDUCER FULL RANGE (10Vdc) IN TORR	ZEROING PRESSURE IN MICRONS	
	NUMBER OF READOUT DIGITS	
	3 1/2	4 1/2
1000	1000	100
100	100	10
10	10	1
1	1	0.1

Overpressuring the transducer will produce a dc output, with degraded accuracy, up to about 130% of fullscale. Higher overpressure will produce no further change in output. Care should be taken not to overpressure the unit beyond the specifications.

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2.3 Special Operating Procedures

To achieve optimum stability several steps may be taken:

2.3.1 Insulate the sensor from transient sources of heat or cold such as drafts, heaters, air conditioners etc: Temperature changes can also be introduced by way of the pressure connection.

2.3.2 Mechanical vibration will cause noisy pressure readings particularly in low range absolute transducers where air damping of the diaphragm is absent. To minimize vibration problems, such as may occur from motor driven vacuum pumps, the sensor can be mounted to a padded support and a metal bellows inserted between the pressure port and the source of vibration. Plastic or rubber pressure connection tubing should be avoided at low absolute pressures. They will outgas and give false pressure readings.

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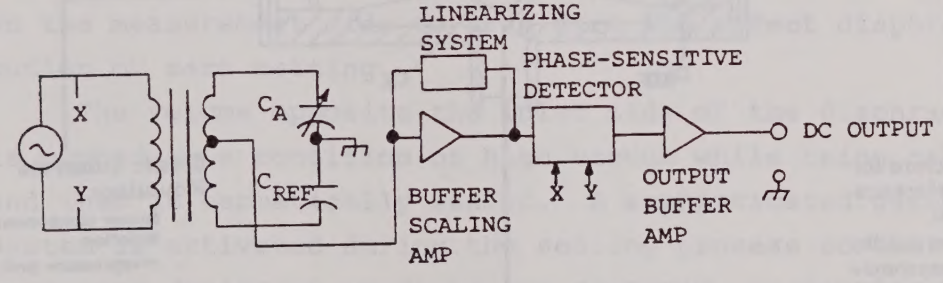
SECTION III
THEORY OF OPERATION

3.1 Detailed Description

Input pressure deflects a thin, radially-tensioned diaphragm whose position is measured by converting the displacement into a variation in electrical capacitance. This varying capacitance forms one element of a fixed frequency, constant excitation level bridge circuit. Changes in capacitance caused by pressure unbalances the bridge, and produces an ac signal related to pressure.

After electrically scaling the ac signal, it is demodulated with a phase-sensitive detector to convert it into a dc voltage. The bridge output signal feeds into a high impedance amplifier whose characteristics are adjusted to linearize the signal so that the output dc voltage may be made linear to 0.05% of applied pressure.



The ac transformer driven capacitance bridge circuit and phase sensitive demodulation process produce a high level dc output proportional to pressure. The technique enables the output signal to be resolved to below one part in 10,000. Low-frequency electrical noise rejection is inherent in the system. High frequency (RFI) noise protection is also employed.

The input pressure media is totally isolated from the diaphragm motion sensing electrode by the diaphragm itself.

The reference capacitance electrode (C_{REF}) and the

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DESIGN FEATURES

Oscillator / Phase Sensitive Demodulating System:

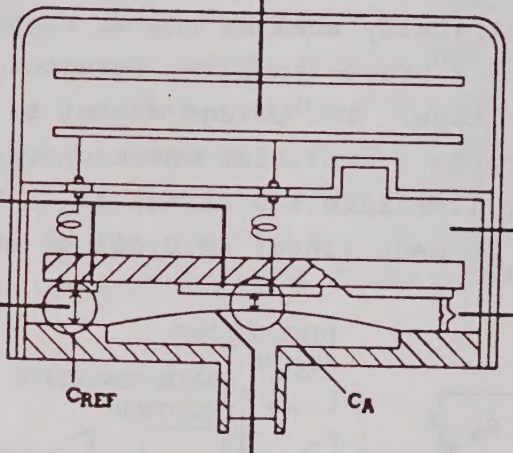
- state-of-the-art electronics dependability
- simplicity of design

Electrodes Isolated from Pressure Media:

- system unaffected by media dielectric or composition
- easy cleaning
- only Inconel® exposed to process media

Self-Contained Vacuum Reference:

- long life
- convenience in making absolute pressure measurements



Unitized Structure for Active and Reference Capacitances:

- superior zero stability
- very low temperature coefficients

Elastic Substrate Mounting:

- sensor component stress isolation
- overpressure protection

Radially-Tensioned Diaphragm:

- low hysteresis
- high strength
- high corrosion resistance

diaphragm motion sensing electrode (C_A) are formed by "thick films" fired onto a massive one-piece ceramic substrate. The diaphragm and its support plate are also a one-piece construction. The capacitances created by mounting the substrate close to the plate are connected into an electronic bridge circuit. Dimensional changes in the spacing of the electrodes due to differential thermal coefficients of expansion of the structures (either motion parallel to the diaphragm or perpendicular to it) cause each of the capacitances to change by the same fractional amount, but produce no change in bridge output.

The pressure-sensing diaphragm is formed from cold rolled Inconel foil as thin as 0.0004 inch in low-range units, but fully gas tight. While under high radial tension, the diaphragm is fusion welded to the tension supporting plate, forming an extremely stable, precisely-constructed mechnical structure. Because of the diaphragm suspension technique employed, there is no weld crevice on the measurement side to trap dirt and affect diaphragm motion or zero setting.

The volume opposite the inlet side of the diaphragm is pumped to a condition of high vacuum while being baked and then is hermetically sealed. A sophisticated gettering system is activated during the sealing process so that long-term degassing products are consumed, preserving the integrity of the high-vacuum reference.

The ceramic substrate is mechanically attached to the diaphragm tension plate by a fully-elastic system. This mounting absorbs stress induced by differential thermal expansion coefficients of the system (and transient temperature changes) eliminating hysteresis induced by temperature changes. Further, the strength of the substrate carries the forces from overpressure, and the elasticity of the mounting system eliminates non-repeatability effects.

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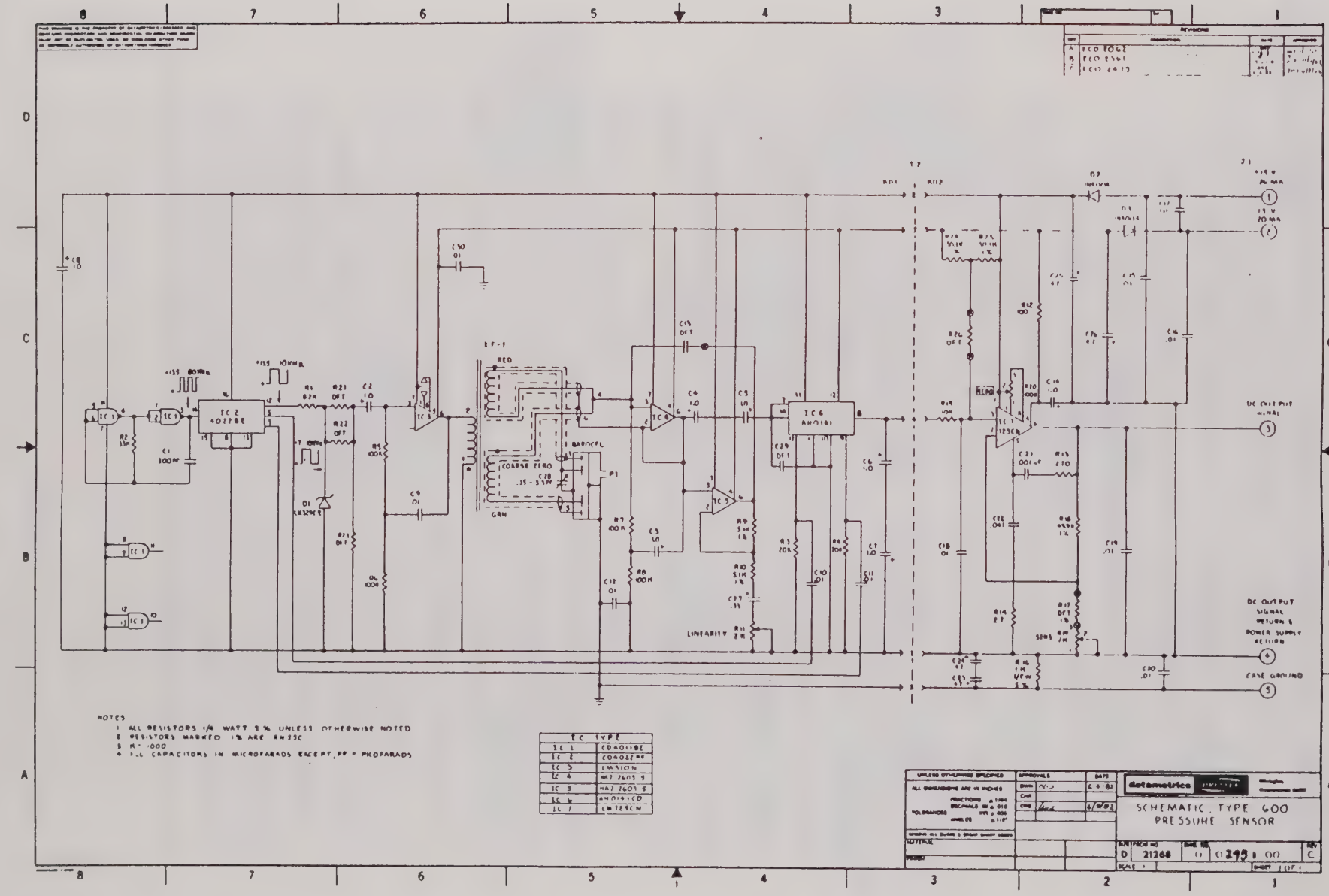
IC 1 CD4011BE
IC 2 CD4027BE
IC 3 LM310N
IC 4 MAX 260T 5
IC 5 MAX 260T 5
IC 6 AM9161
IC 7 LM329CN
NOTES
1 ALL RESISTORS 1/4 WATT 5% UNLESS OTHERWISE NOTED
2 RESISTORS MARKED 1% ARE RN55C
3 M = 1000
4 ALL CAPACITORS IN MICROFARADS EXCEPT PF = PICOFARADS
COARSE ZERO
LINEARITY
DC OUTPUT SIGNAL
DC OUTPUT SIGNAL RETURN & POWER SUPPLY RETURN
CASE GROUND
datametrics
SCHEMATIC, TYPE 600 PRESSURE SENSOR
D 21268
0 0295 00
C

SCHEMATICS

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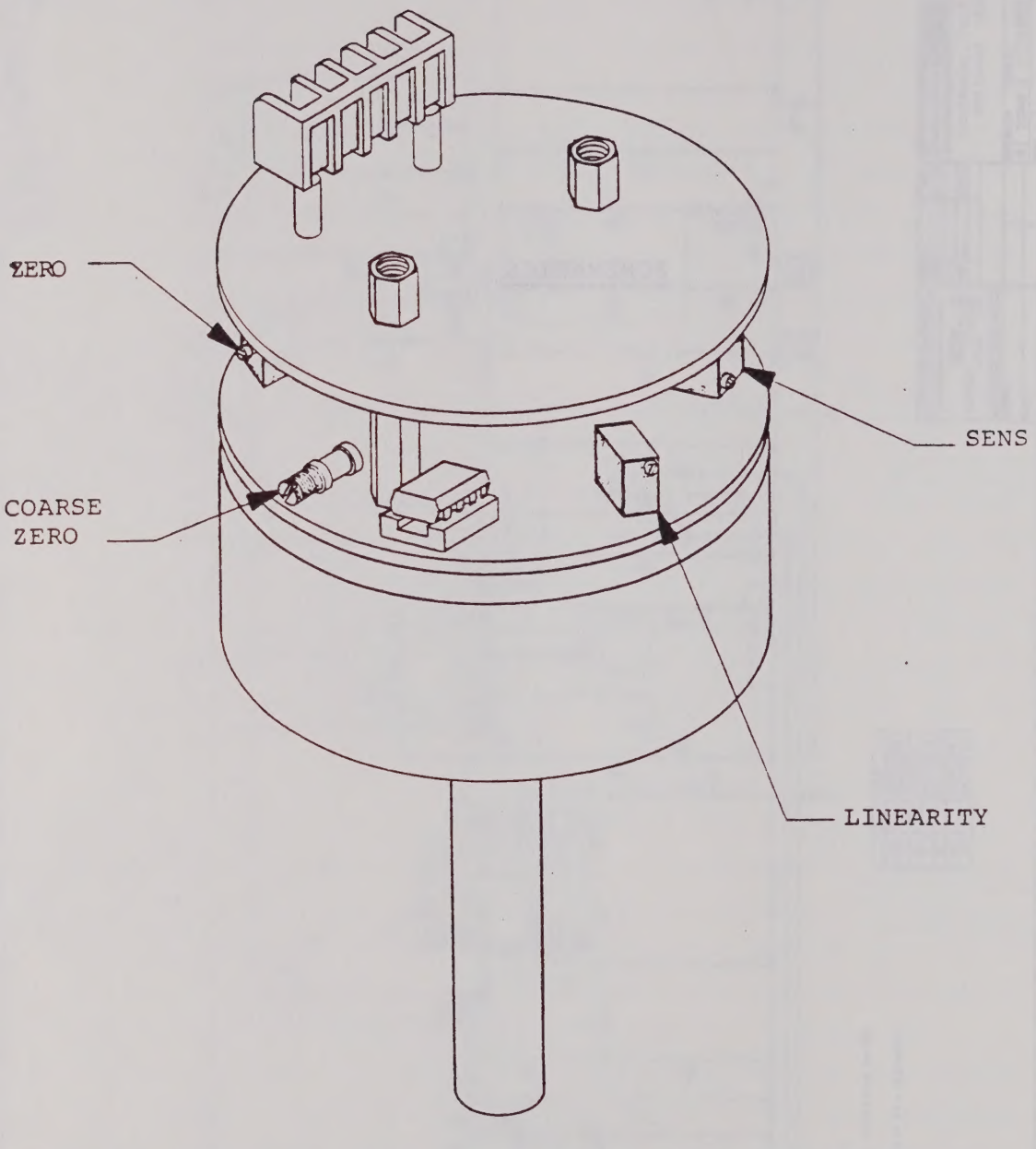

NOTE: SOME UNITS HAVE THE POSITION OF ZERO AND SENS ADJUSTMENTS REVERSED. THE POSITION OF ZERO ADJUSTMENT WILL ALWAYS MATCH THE HOLE IN THE COVER.

FIGURE 3

SECTION IV
MAINTENANCE

4.1 Routine Maintenance

No routine maintenance is necessary if the gases being measured are clean. See 4.2 for cleaning instructions. The zero can be checked and set as outlined in Section 2.2. To adjust the slope see Section 4.3.

4.2 Special Maintenance

Should the gases being measured contain oil vapor or other condensable products the diaphragm may become coated which may cause zero and calibration shifts. Any solvent that is compatable with Inconel and 18-8 stainless steel may be used to dissolve the condensate and flush out the sensor.

NOTE: This applies only to the unknown pressure port, not to the reference port of differential transducers. Care must be taken to keep the solvent out of the electronics cavity.

4.3 Recalibration

If adequate pressure standards are available the sensor may be recalibrated. Adjustment of the linearity is complex and is not advised. The location of the COARSE ZERO and SENS (sensitivity) controls are shown in Figure 3. Note that both the zero and sensitivity change slightly with the cover removed.

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